THESIS,

THE PRESERVATION OF TIMBER,

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BY

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THE PRESERVATION OF TIMBER.

It is amply shown by statistics that our Northern white pine forests are rapidly being exhausted and it is estimated, that at the present rate of consumption, they bid fair to furnish only about eleven years more of supply, although formerly deemed almost inexhaustable. This is true of our other forest, to some extent, as well.

The efficient and economic preservation of the timber in such structures as will subject them easily to decay, becomes then a question of primary importance, especially so in extensive engineering works.

A few words as to the chemical composition, as well as to the causes of decay of wood would perhaps be appropriate here. Chemists agree that pure woody fibre consists of about 52.4 parts of carbon, 41.9 parts of oxygen and 5.7 parts of hydrogen; this varying but slightly in different kinds of wood.

As to the causes of decay: the origin is undoubtedly with the sap, since woody fibres alone will not decay. The sap is mainly composed of sugar, starch and resin, with additional and comparatively large quantities of water. The fermentation of this sap

and its subsequent action on the fibres brings on the decay. The necessary conditions to produce the result are:

(1) The wood must contain the elements or germs of fermentation while being exposed to the atmosphere and water.

(2) A sufficient amount of moisture must be present to induce the fermentation.

(3) In order that the products resulting therefrom may oxidize, air must be present, and finally

(4) The temperature must be from about 50 deg. to 100 deg. Fahrenheit. No decay takes place above 150 nor below 32 degrees.

In order to enhance the durability of wood most efficiently, two phases of the question present themselves, namely:

First. The removal of the sap as effectively as may practicably be done. This consists in:

(a) Felling the trees in winter because then they contain the least sap.

(b) Barking the trees while yet standing.

(c) Drying the timber in air or, otherwise, in rooms heated for the purpose.

(d) Extracting the sap by means of water; and

(e) Steaming the timber in closed vessels.

Second. The protection of the remaining sap sap from decay by some appropriate means. There are but few anti-septics which have stood the test of time, although experi ments in preserving timber extend back several centuries. The following are the only methods that have thus far proven themselves to be effective, and the discussion of their individual and relative merits will be the object of this paper. The names of the methods are: Burnettizing, Kyanizing, Creosoting, Boucherie Process, and divers other methods which are not of much importance, however owing to the poor success with which they have met and they will be only superficially dwelt upon .

BURNETTIZING.

This consisted originally in steeping the timber in a solution of chloride of zinc, but the "Bethell Process" has been substituted for it. This process is the placing of the timber in a closed vessel, exhausting the air in order to extract the sap and water, and eventually forcing the preserving liquid into the vessel under high pressure. Later still steam has been employed in the extraction of the sap.

Burnettizing was first introduced in this country at Lowell Massachusetts in 1850 and has been extensively experimented upon. In employing this process several precautions should be taken.

The proportion of the salt in the solution is of primary importance. The original proportion was one pound of the salt to about four gallons of water. It has been found that an excess of the salt diminishes the strenght and elasticity of the wood, making it brittle. This is caused by the crystallization of the salt in the pores of the wood and upon expanding bursting assunder the cells. An instance is cited in the "Transactions of the American Society of Civil Engineers" of a case in which the wood had been injected with so large an amount of the chloride of zinc, that the rail road ties employed were broken during the simple process of unloading.

Although thereis, then, this objection to overdoing the process, caution should be observed on the other hand , not to employ too small an amount of the salt. There is the danger of its being washed out by rains and moisture when the solution is too week. In Germany experiance has shown that the solution should not contain more than two per cent of the salt, while 1.9 is the standard

for rail road ties. This fact has also been confirmed in American experience, as for example in the Chicago Rock Island & Pacific Railroad where hemlock ties were used and after an exposure of sixteen years found to be almost undecayed. Another example is given in the Lehigh Valley Road, the time of exposure being about fifteen years and the condition of the timber being as in the former case.

Another danger is that of the washing out of the zinc by acidulated water , and it is for this reason probably, that it is less apt to wash out when the ties are covered with earth and grass.

Burnettizing is undoubtedly less adapted to bridge work that it is to railroad ties. One reason being the weakening of the timber and another the ease with which acidulated water gains access. In all cases , however, where Burnettizing is employed it be well done, taking care to remove the sap and moisture, and to impregnate the timber well with the anti-septic.

It would hardly be wise to prpare wood by this method or any other for a railroad in process of rapid construction, as there is too much danger of hurrying the work and consequently doing it inefficiently and further more the cost of the necessary plant would be too great.

The cost of Burnettizing is at present about $5.oo per 1000. feet board measure or from twenty to twenty five cents per tie.

KYANIZING.

This process was introduced in 1832. It consists in steeping the timber in what is commonly called a solution of corrosive sublimate. This substance is the most powerful anti-septic known, next to creosote. The original proportion of the solution was one pound of the dry salt, to four gallons of water, which made it very expensive. This led to a more sparing use of it, so that the solution was finally reduced to one pound of the salt to ten gallons and in some cases even to fifteen gallons of water.

The great cost had a tendency to induce worthless imitations and in England it has been entirely rejected. In this country however it has been quite successful in a good many instances. The Alexandrian aqueduct at Georgetown D. C. , for example consisting of a nine span Burr truss bridge, built in 1840, was taken down only in 1862 and the timber was found to be almost entirely undecayed. Again the wood employed in the Blackstone river bridge on

the New York and New England Railroad was perfectly sound after an exposure of about twenty eight years, and so effectual had the preservation been that the bottoms of the posts in it were but slightly decayed, in some cases they were perfectly sound.

Kyanized railroad ties being subject to moisture or at least more so than structure exposed to the weather alone, such as bridges, trestle works &c, are more easily deprived of the antiseptic than are the latter. Besides this it does not weaken the timber as does the Burnettizing process.

From the above consideration it would seem that in such structures as bridges, trestle works, fences and others of a similar nature the Kyanizing process would be the most advantageous one to use while in rail road ties or in any case in which the wood is laid open to constant moisture this process would not be reccommendable.

The present cost varies from $5.oo to $6.oo per one thousand feet board measure.

One other experiment deserves especial mention in this connection namely: A number of Kyanized posts of various kinds of wood were placed in the ground and at a small distance from them, so as to insure the same conditions in both cases were planted unprepared posts of the same kind of wood, each post having been cut from the

same piece as its corresponding mate. After an exposure of twenty two years the former were decayed but very little and mostly only under the ground, the amount of the decay verying slightly with the different varieties. On the other hand the unprepared posts were decayed to such an extent as to make it impossible to draw them out of the ground without breaking them . This experiment confirms the above statments.

CREOSOTING.

This process stands pre-eminent among all known processes of preserving timber granting however that it be well done and were it not for its great cost in this country as comparred with the other processes it would doubtlessly be universally employed here as it is now extensively done in Great Britain and other European countries.

The method used in impregnating the timber with the anti-septic(creosote oil) is called the Bethell process and is conducted as follows:

The sap having first been removed by exhausting the air from the large cylinder in which the wood to be operated upon has

been placed, hot creosote oil is let in and subjected to great pressure, thus injecting the oil into the wood. porous wood well seasoned is preferable in all cases.

Creosote is the most powerful anti-septic known at the present time . The process of creosoting is applicable in all cases, whether the wood be exposed to moisture or not. In this country, however, it has, with one or two notable exceptions, one of which will be mentioned farther on, met with little success. The reason is that true creosoting was not done. The great cost induced many to try to achieve the same results that were obtained in Europe, by imitation and by employing methods thought to be just as efficient, such for instance was the attempt made to preserve timber by saturating it with vapors of coal tar. All these imitations were, of course unfruitful.

Timber treated with creosote oil has another great advantage. This oil is the only known anti-septic which when properly applied protects the wood compltely from the ravages of the teredo navalis, limnoria terebians of whose great distructiveness we have a forcible example in the utter annihilation of a railroad built along the Gulf of Mexico, whereever it was necessary to run the line through the Gulf on piles.

The amount of oil necessary per cubic foot depends on the climate. In England from ten to twelve pounds per cubic foot is deemed sufficient for their harbors. The French consider nineteen pounds necessary to be quite safe against the teredo. This is the amount used in this country for piles exposed along the Gulf of Mexico in the reconstruction of the railroad above mentioned and was found to be wholly effective.

The only objection to the employment of creosoting in this country is its great cost and it is never applied except in such cases as that of the "New Orleans and Mobile Railroad" when the wood is to be protected from the marine worms.

COPPER SULPHATE PROCESS.

This process though having met with some success in a few cases has on thw whole proven to be of little value owing to the ease with which the copper is removed from the wood. The causes of this removal are the presence of iron, the presence of saline solutions and finally, of carbonic acid. Numerous other methods have been tried in this country, as well as abroad, none of which have attributed any thing to the preservation of timber,

resulting in most cases in complete failures.

Conclusion.

From the above discussion it seems that the process which should be employed depends mainly on the circumstances involved.

When railroad ties or wood subjected to similar conditions are to be preserved kyanizing should be employed.

In bridges, trestle work, and timber exposed to the action of the weather alone the Burnettizing process seems to be of the greatest utility.

Lastly, when the timber is to be protected against the teredo navalis and the limnoris terebians creosoting is the only manner in which this can be achieved.

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